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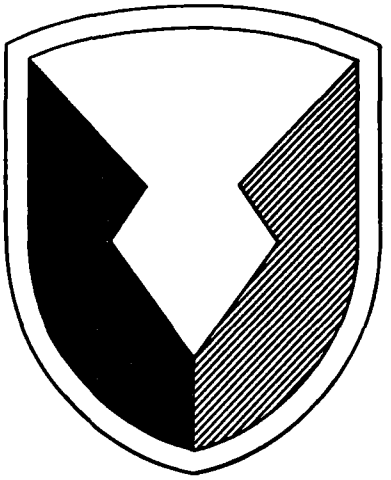
US ARMY TEST & EVALUATION COMMAND



FINAL

REPORT OF

PRODUCT IMPROVEMENT TEST

OF THE

HELMET, FLYING, FRAGMENTATION PROTECTIVE

(IMPROVED APH-5)

DA PROJECT NO. - NONE

USATECOM PROJECT NO. 4-4-4335-01

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AVIATION TEST BOARD

FORT RUCKER, ALABAMA

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(16) USATECOM [redacted] -4-4-4335-01

A. J. RANKIN
COLONEL, ARMOR
PRESIDENT

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ABSTRACT

The US Army Aviation Test Board conducted a product improvement test of the Helmet, Flying, Fragmentation Protective (Improved APH-5) during the period 15 May to 15 June 1964. The helmets were worn by aviators from the US Army Aviation Test Board, US Army Aviation School, US Army Board for Aviation Accident Research, and US Army Aeromedical Research Unit. Although the modifications adversely affected some of the essential characteristics, if the deficiencies are corrected, the helmet, because of its ballistic-resistant nylon construction, will be a significant improvement over the standard APH-5. Of the two types of sizing pads tested, the experimental sizing pad better met the Army requirement. The carrying bag provided more protection than the APH-5 bag and provided space for carrying additional useful items. Five deficiencies and twelve shortcomings were noted during the test. It was concluded that the test helmet will be more suitable than the standard APH-5 helmet when the deficiencies are corrected and that the experimental carrying bag is superior to the present APH-5 carrying bag. It was recommended that the deficiencies be corrected and the helmet and carrying bag be accepted as a product improvement of the standard APH-5 helmet and carrying bag.

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SECTION 1 - GENERAL

1.1. REFERENCES.

1. Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 9 August 1963, subject: "Directive for Service Test of Helmet, Flying, Fragmentation, Protective, USATECOM Project No. 4-4-6010-01."

2. Plan of Test, USATECOM Project No. 4-4-6010-01, "Service Test of Helmet, Flying, Fragmentation, Protective," US Army Aviation Test Board, 26 October 1963.

3. Report of Test, USATECOM Project No. 4-4-6010-01, "Service Test of Helmet, Flying, Fragmentation Protective," US Army Aviation Test Board, 11 March 1964.

4. Plan of Test, USATECOM Project No. 4-4-4335-01, "Product Improvement Testing of Helmet, Flying, Fragmentation, Protective," US Army Aviation Test Board, undated, as changed 3 June 1964.

1.2. AUTHORITY.

1.2.1. *Directive.*

Letter, AMSTE-BG, Headquarters, US Army Test and Evaluation Command, 7 April 1964, subject: "Test Directive, USATECOM Project No. 4-4-4335-01, Product Improvement Test of Helmet, Flying, Fragmentation, Protective," (improved APH-5) with two inclosures.

1.2.2. Purpose.

To determine whether the characteristics of the test item have been adversely affected by the modifications incorporated, when compared with the standard helmet.

1.3. OBJECTIVES.

To determine:

a. Modification effects on user aspects.

b. Compatibility with existing aviator required impedimenta.

c. Sizing pads which best meet the Army requirements.

d. Suitability of the carrying bag.

e. Durability.

f. Maintenance requirements.

1.4. RESPONSIBILITIES.

The US Army Aviation Test Board (USAAVNTBD) was responsible for test plan preparation, test supervision, and test reporting.

1.5. DESCRIPTION OF MATERIEL.

The test item is a modified APH-5 helmet with a carrying bag made of padded, water-resistant material. The helmet is made of ballistic-resistant nylon, laminated with 35 to 40 percent modified phenolic resin. It has an energy-absorbent liner made of expanded plastic. For size adjustment, both the standard leather-covered sizing pad and a new experimental fabric-covered pad were furnished. Integrated with the helmet is a retractable visor, earphones, microphone, and nape and chin straps with pads.

1.6. BACKGROUND.

The APH-5 helmet is the current standard Army aircrewman headgear. The helmet was designed by the Navy and adopted for Army use. In September 1961, a Task Group was established to study the problems associated with aircrewman headgear and to recommend the best way to provide a helmet with the desired characteristics. The Task Group recommended that a helmet to replace the APH-5 be provided as soon as possible, incorporating appropriate state-of-the-art improvements. In January 1963, US Army Natick Laboratories was assigned responsibility for designing and developing a helmet that would provide increased crash and ballistic protection over the present APH-5 helmet. This program resulted in a modified APH-5 which was submitted for testing in September 1963. Testing was conducted during the period 18 October through 18 November 1963. The helmet was found to be an unsatisfactory replacement for the current APH-5. The current test item was further modified to correct the deficiencies noted

during the previous test. Six helmets, three medium and three large, with carrying bags were received by the USAAVNTBD on 17 April 1964.

1.7. FINDINGS.

1.7.1. Although the modification of the APH-5 helmet has adversely affected some of the essential characteristics, if the deficiencies listed in appendix I are corrected, the helmet, because of its ballistic-resistant nylon construction, will be a significant improvement over the standard APH-5.

1.7.2. The helmet was compatible with existing aviator chemical, biological, and radiological (CBR) protective equipment, ejection seats, and aircraft communication equipment except the oxygen mask microphone.

1.7.3. Of the two types of sizing pads tested, the experimental sizing pad better met the Army requirement.

1.7.4. The carrying bag provided more protection than the APH-5 bag and provided space for carrying additional useful items.

1.7.5. The modified helmet and carrying bag were sufficiently durable for Army use.

1.7.6. Maintenance requirements were not excessive.

1.8. CONCLUSIONS.

1.8.1. The test helmet will be more suitable than the standard APH-5 helmet when the deficiencies listed in appendix I are corrected.

1.8.2. The experimental carrying bag is superior to the present APH-5 carrying bag.

1.9. RECOMMENDATIONS.

It is recommended that:

1.9.1. The deficiencies listed in appendix I be corrected and the helmet and carrying bag be accepted as a product improvement of the standard APH-5 helmet and carrying bag.

1.9.2. The shortcomings listed in appendix I be corrected as technically and economically feasible.

SECTION 2 - DETAILS AND RESULTS OF SUB-TESTS

2.0. INTRODUCTION.

2.0.1. The helmets were worn for approximately 400 flying hours during the period 15 May to 15 June 1964 by aviators from the US Army Aviation Test Board, US Army Aviation School, US Army Board for Aviation Accident Research, and US Army Aeromedical Research Unit. This user test exposed the helmet and carrying bag to usage in an Army environment by Army aviators with the intent of determining whether the essential characteristics of the APH-5 helmet had been adversely affected by the modifications incorporated.

2.0.2. Characteristics such as durability and maintenance requirements were difficult to determine fully in 30 days; however, findings were significant.

2.0.3. Compatibility with ejection seats was not tested by an actual ejection sequence, but the helmet was worn for 100 flying hours in an OV-1 "Mohawk" airplane equipped with an ejection seat.

2.0.4. Although the sizing pad furnished for comparison with the present APH-5 standard sizing pad is referred to as an experimental pad, it is the standard pad for current US Air Force protective helmets.

2.1. USER EVALUATION.

2.1.1. Objective.

To determine the effect of the test item modifications on user aspects by comparison with the standard helmet.

2.1.2. Method.

The test helmets were worn by selected US Army Aviation Test Board aviators during training and test associated flights. Helmets were also worn by aviators from the US Army Aviation School, the US Army Board for Aviation Accident Research, and the US Army Aeromedical Research Unit. Helmets were fitted to five aviators by the test project officer, and five additional aviators fitted themselves relying solely on the written instructions furnished by Natick Laboratories. A questionnaire (attached as appendix II) was completed by

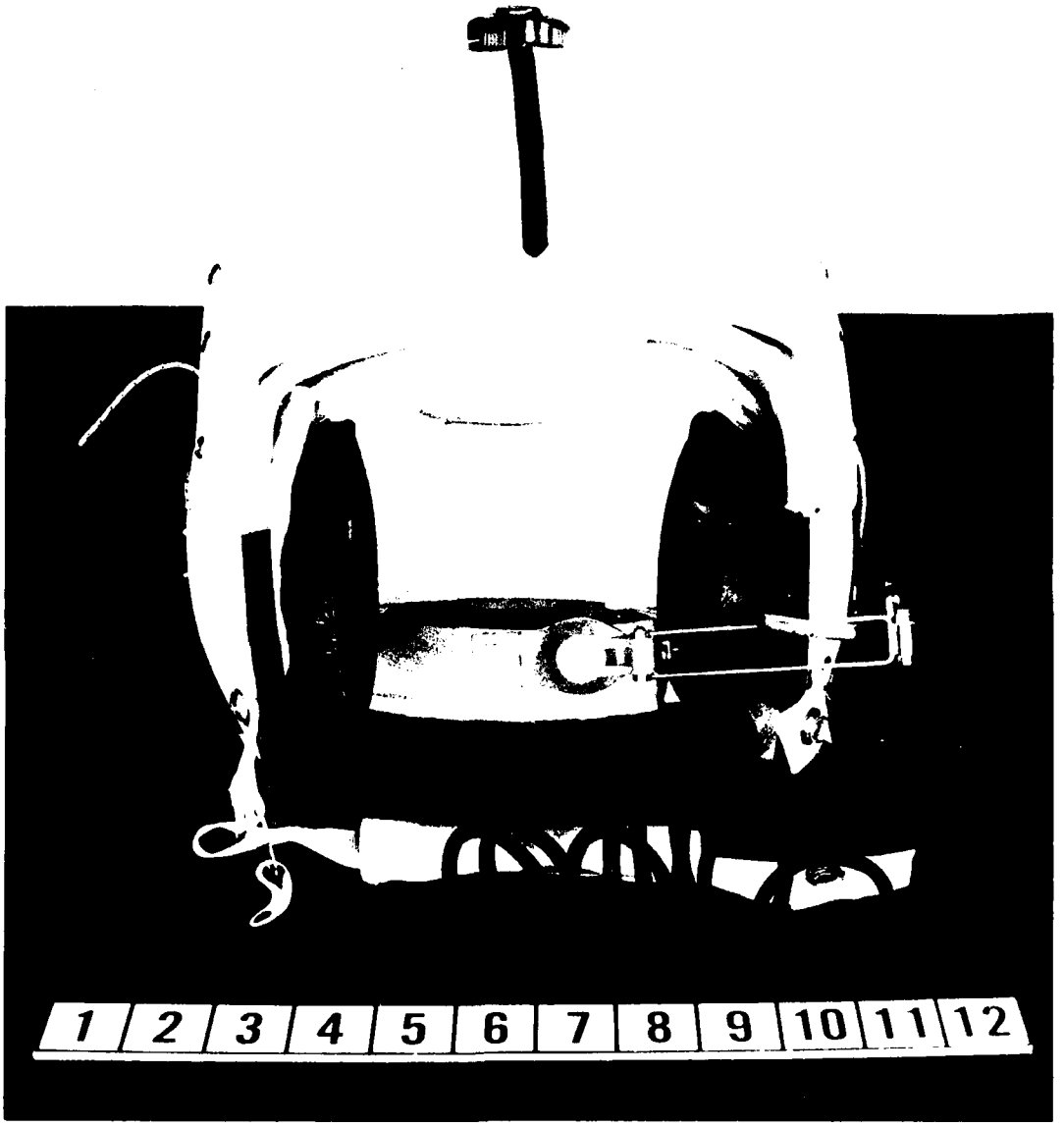

Figure 1. Front view of helmet (sizing pads installed)

each participating aviator or activity. The questionnaires were evaluated and comments on the effect of APH-5 modification on user aspects are summarized below.

2.1.3. Results.

2.1.3.1. Fitting. The written instructions were inadequate for fitting the experimental pads and resulted in poor fits in three instances.

2.1.3.2. Donning and Doffing. When the helmet was donned, the chin strap pad occasionally slipped off the chin strap and the nape strap twisted, but the helmet was no more difficult to don or doff than the standard APH-5 helmet.

2.1.3.3. Peripheral Vision. No difference was noted between this helmet and the standard APH-5.

2.1.3.4. Glare Visor. The visor was effective and caused no discernible distortion when used with or without corrective lenses. The material was soft and easily scratched. The sharp lower edge was a safety hazard. One visor was broken by the stress concentration of the visor locking button assembly. (See figure 2.)

2.1.3.5. Security. When properly fitted and tightened, the helmet remained secure during all movements.

2.1.3.6. Ambient Noise Suppression. The helmet was equal to the standard APH-5 in ambient noise suppression.

2.1.3.7. Communication. One earphone assembly became inoperative and was replaced. A defective (undersized) communications cord plug caused intermittent reception until replaced. Microphone booms loosened with use and allowed the microphones to swing away from the user's lips.

2.1.4. Analysis.

The modifications have adversely affected certain user aspects of the item. However, when the deficiencies listed in appendix I are corrected, the helmet will be a significant improvement over the standard APH-5 because of its nylon construction which increases crash and ballistic resistance.

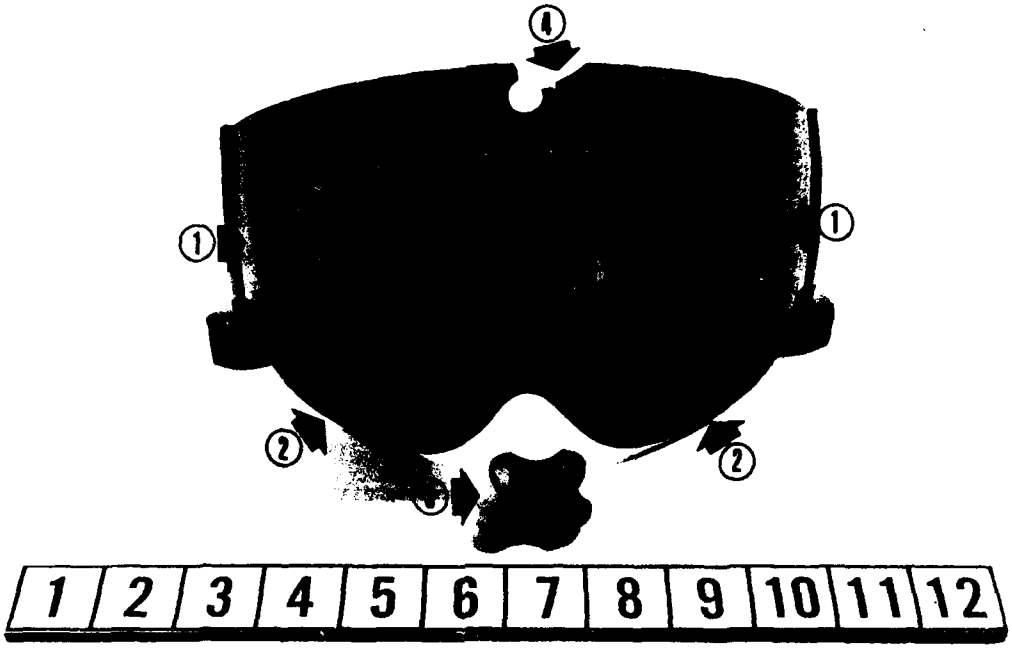

Figure 2. Glare visor and locking button

Arrow 1: Scratched areas
Arrow 2: Sharp edges
Arrow 3: Visor locking button
Arrow 4: Area broken by locking button

2.2. COMPATIBILITY TEST.

2.2.1. Objective.

To determine the compatibilty of the test item with existing aviator required impedimenta.

2.2.2. Method.

A comparative check (with the standard APH-5 helmet) was made to determine the helmet's compatibility with:

a. M-24 Aircraft Protective Mask.

b. E-45 Hood.

c. Aircraft communications system.

d. Seat ejection system.

2.2.3. Results.

2.2.3.1. The helmet was compatible with the M-24 pilot's protective mask, the E-45 hood, and with current aircraft communication systems and components except for the oxygen mask (MS 22001) microphone. No provisions were present for quickly disconnecting the helmet microphone for easy attachment to the oxygen mask microphone. The prongs on the boom microphone plug were secured within the microphone by set screws and were not readily detachable. Once disconnected, the boom plug would not connect to the oxygen mask microphone cord because both had male or pronged plugs. The standard APH-5 has a disconnect point on the outside of the helmet shell below and to the rear of the boom microphone support and a quick switch of microphones could be made.

2.2.3.2. The helmet was compatible with the seat ejection system. The communication cord was attached to the helmet on the lower left side and did not interfere with positioning the head on the ejection seat headrest as did the standard APH-5 rear attachment.

2.2.4. Analysis.

The helmet was usable with existing aviator required impedimenta; however, provisions should be made for quickly and easily

detaching the microphone cord from the boom mike and expeditiously attaching it to the oxygen mask microphone.

2.3. SUITABILITY OF THE SIZING PADS.

2.3.1. Objective.

To determine which sizing pad (2 types) better meets the Army requirements.

2.3.2. Method.

The helmets were fitted and worn by ten aviators with head sizes ranging from 6 7/8 to 7 1/2 using both types of pads.

2.3.3. Results.

2.3.3.1. Aviators found both the standard and the experimental type pads acceptable. The experimental type absorbed more perspiration and was more comfortable in hot weather but was easily soiled. The adhesive for retaining the pads was adequate only when the pads were correctly placed on the first fitting. Some peeling of the fabric covering occurred along the leading edge of the pad that fitted next to the forehead. When only one or two experimental pads were used in each position (front, back, and top), helmet stability was slightly improved over a helmet fitted with the thick pads of the standard type.

2.3.3.2. Written instructions and descriptions furnished by US Army Natick Laboratories for the experimental pads were inadequate. Consequently, confusion existed about identification and placement of the pads.

2.3.4. Analysis.

2.3.4.1. The outer pad (buffeting pad) of the experimental type should be bonded to the styrofoam liner by the helmet manufacturer to insure better adhesion and correct placement of subsequent sizing pads.

2.3.4.2. The thin inner pad of the experimental type allows less compression than the thick pad of the standard type. Consequently, stability is better with the experimental pads if the user can be fitted without the center foam rubber sizing pad.

2.3.4.3. The experimental pad will be more satisfactory when it is properly installed and when the inner pad is replaced periodically after becoming soiled from use.

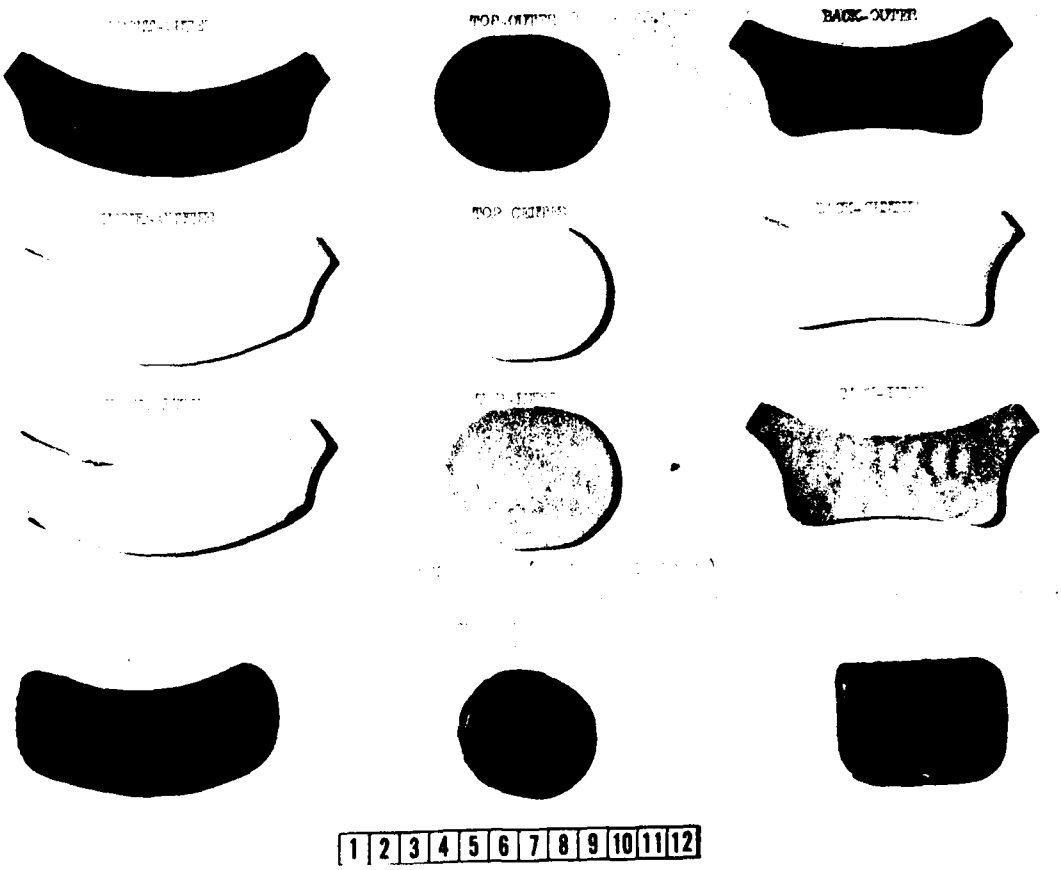

Figure 3. Sizing pads

Figure 4. Carrying Bag

2.4. SUITABILITY OF CARRYING BAG.

2.4.1. Objective.

To determine the suitability of the carrying bag.

2.4.2. Method.

Each aviator was asked to use a test helmet and carrying bag and to comment on the utility and practicability of the carrying bag.

2.4.3. Results.

The helmet was easy to insert and remove. Aviators found that the padded, water-resistant bag offered increased buffeting protection for the helmet. They used the extra space and sidepockets for carrying charts, gloves, flashlights, checklists, etc.

2.4.4. Analysis.

The new carrying bag is functional, practical, and more suitable for Army use than the old carrying bag.

2.5. DURABILITY.

2.5.1. Objective.

To determine the durability of the test item.

2.5.2. Method.

The helmets and carrying bags were given normal usage and the general condition of each at test termination was noted.

2.5.3. Results.

Helmets and carrying bags were in a serviceable condition at test completion. No defects occurred in the helmet shells; however, during the test the following were noted:

a. Microphone boom screws loosened repeatedly.

b. Visor adjusting buttons became detached.

c. Glare visor was scratched by visor housing.

d. Styrofoam liner came loose in places.

e. Ear muff outer layer peeled.

f. Communications cord was inadequately secured.

g. Carrying bag zipper popped open in normal use.

h. Paint stenciled on the bag flaked off, making the bag unsightly.

i. Earphone became inoperative.

j. Visor was broken by visor adjusting button.

2.5.4. Analysis.

The helmet and carrying bag are sufficiently durable for Army use. Indications are that the nylon shell is significantly stronger and more serviceable than the fiberglass shell of the standard APH-5.

2.6. MAINTENANCE REQUIREMENTS.

2.6.1. Objective.

To determine the maintenance requirements of the test item.

2.6.2. Method.

All maintenance requirements were noted to include defective items and/or components that failed.

2.6.3. Results.

2.6.3.1. Aviators made minor repairs such as tightening screws in the visor housing and microphone boom, replacing a microphone cover, securing the cord inside the lower rear edge of the helmet, and replacing the visor locking button assembly.

2.6.3.2. The Signal Field Maintenance Shop replaced an inoperative earphone assembly and a defective communications cord plug.

2.6.3.3. A detailed list of deficiencies and shortcomings is contained in appendix I.

2.6.4. Analysis.

The maintenance requirements of the test item are comparable to those of the standard helmet.

SECTION 3

APPENDICES

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APPENDIX I

DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES.

Deficiency	Suggested Corrective Action	Remarks
1. Visor edge was sharp.	Burnish or cover with rubber.	This is a safety hazard to user's nose and face.
2. Visors were scratched easily.	Shape visor housing to provide adequate visor clearance.	Visor covers were not symmetrical. Scratched visors are a safety hazard.
3. Visor locking button broke the visor on one helmet.	Widen base portion of assembly to increase visor contact for better force distribution.	This is a design deficiency.
4. Visor locking button assembly came off during positioning of visor.	Provide a close tolerance fit.	None.
5. Microphone cord plug would not connect to oxygen mask microphone.	Provide female plug on microphone cord.	None.

2. SHORTCOMINGS.

Shortcomings	Suggested Corrective Action	Remarks
1. Screws loosened easily in visor housing.	Tighten and brad securely during production.	Styrofoam liner prevents holding of nut for tightening. Loose screws allowed movement of housing and binding of visor.

Shortcoming	Suggested Corrective Action	Remarks
2. Main styrofoam liner separated from helmet shell.	Provide better bonding of styrofoam to helmet shell.	Changing of pads contributed to this separation.
3. Wedge-shaped styrofoam liner separated from helmet shell.	Provide better bonding of styrofoam to helmet shell.	This wedge-shaped piece was added along front edge of helmet.
4. Microphone boom screws loosened easily.	Use a longer screw and a lock washer and insert screw from top of microphone boom.	Screws were inserted from bottom and continually loosened and dropped out.
5. Communications cord was not coiled.	Coil all cords.	Straight cords become entangled and restrict head movement.
6. Cord on inside rear of helmet was not adequately secured.	Use longer retaining clip and better styrofoam bonding.	Retaining clip inserted between styrofoam and helmet shell was too small.
7. Chin strap pad became deformed with use.	Sew thin layer of felt inside cover with slots for chin strap.	Felt liner rolled up within cover.
8. Chin strap pad was insecurely attached to chin strap.	Interlace chin strap through pad cover.	Pads came off while chin strap was unsnapped for donning and doffing.
9. Ear muffs peeled.	Provide a perspiration-resistant ear muff or ear muff covers.	Black outer layer peeled off four ear muffs and exposed a sticky sub-layer.

Shortcoming	Suggested Corrective Action	Remarks
10. Paint on carrying bag flaked off.	Do not stencil bags.	Stenciling is not required.
11. Zipper on carrying bag popped open.	Use a stronger zipper.	Zipper was not heavy-duty type.
12. Written instructions and description furnished by US Army Natick Laboratories for the experimental pads were inadequate.	Provide correct instructions.	Confusion existed about identification and placement of the pads.

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APPENDIX II

HELMET QUESTIONNAIRE

1. How long have you been using a helmet?

2. Approximate hours flown wearing a protective helmet: _____

3. Are the sizing instructions clear and complete?

4. Are the sizing pads adequate? If not, state where deficiencies exist.

5. Did you experience difficulty in fitting the helmet? Note any difficulties.

6. Did you note any inconveniences in donning and doffing the helmet?

7. Was your peripheral vision unduly hampered while wearing the helmet?

8. Was the glare visor used? Comment on effectiveness and distortion. Include comments if worn with corrective glasses.

9. Did the helmet remain secure during all movements while in use?

10. Do you consider the ambient noise adequately suppressed while flying?

11. Did you experiency any communication difficulties attributable to the helmet?

12. Do you consider the helmet storage bag adequate? Note any impressive features.

13. How many flight hours was the test helmet worn and in what type aircraft? List total and number of flights in excess of 2 hours.

14. What particularly impressed you about the helmet? Why?

15. What changes in design of the helmet and storage bag would you recommend?

16. Did your helmet require repairs or adjustment?

17. Which type sizing pads do you prefer?

18. Do you consider this helmet to be a suitable replacement for the standard (fiberglass) APH-5?

APPENDIX III

COORDINATION

The following agencies participated in the review of this report:

US Army Combat Developments Command Aviation Agency

US Army Aviation School

US Army Board for Aviation Accident Research

US Army Aeromedical Research Unit

AD _____ Accession No. _____

United States Army Aviation Test Board, Fort Rucker, Alabama
Report of USATECOM Project No. 4-4-4335-01, Product Improvement Test of the Helmet, Flying, Fragmentation Protective (Improved APH-5), 11 September 1964. DA Project No. - None. 32 pp., 4 illus. Unclassified report. The US Army Aviation Test Board conducted a product improvement test of the Helmet, Flying, Fragmentation Protective (Improved APH-5) during the period 15 May to 15 June 1964. Five deficiencies and twelve shortcomings were noted during the test. It was concluded that the test helmet will be more suitable than the standard APH-5 helmet when the deficiencies are corrected and that the experimental carrying bag is superior to the present APH-5 carrying bag. It was recommended that the deficiencies be corrected and the helmet and carrying bag be accepted as a product improvement of the standard APH-5 helmet and carrying bag.

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